pCO2 (partial pressure of carbon dioxide) was monitored in late summer (late July to mid-August) over a period of 4 years (2013, 2015, 2017, 2018) from open water areas of a variety of aquatic habitats. pCO2 was monitored for a minimum of 30 minutes, to allow measurements to stabilize, up to a maximum of nearly 3 weeks of diel monitoring, depending on the site. At sites monitored on a diel basis, aquatic CO2 was logged every minute using an NDIR CO2 sensor (Vaisala GMM 222) enclosed in a PFTE membrane (sensu (Hari et al. 2008, Johnson et al. 2010, Bass et al. 2012) linked to a Campbell Scientific CR1000 datalogger. At sites where continuous stations were not installed, a portable NDIR CO2 sensor (Vaisala GMT220) was allowed to stabilize for at least 30 minutes before a value was recorded. Data were converted to pCO2 using water temperature and pressure logged with a HOBO U20 logger. CO2 flux (g C/m2/day) was calculated following corrections for diffusive exchange with the atmosphere estimated using wind-derived gas transfer co-efficients (k) (Wanninkhof 2014).

DOC was measured on either a Lachat IL-550 or a Shimadzu TOC-V analyzer. DOC was measured as non-purgeable organic carbon (NPOC) on the Shimadzu instrument; data from the Lachat were converted to NPOC based on samples run on both machines (n=86; range 1.9 to 68 mg/L NPOC; r2=0.98).

Downward total solar irradiance data were retrieved from Barrow Atmospheric Baseline Observatory (NOAA ESRL) prior to 2017. Post-2017, these data were acquired from NEON's Barrow Environmental Observatory Site (National Ecological Observatory Network 2018). A comparison between the 2 sites in 2017 was used to standardize the data among years (r2=0.97). Photosynthetically active radiation (PAR), air temperature and rain data were collected from a HOBO weather station installed near IBP Pond C until 2013. Starting in 2015, rain data were retrieved from the National Weather Service, Barrow Airport; air temperatures and atmospheric CO2 were from NOAA ESRL. For identification of unusual temperature and radiation conditions, we calculated the 95th percentile of each of these based on all data from July and August in the 4 study years (2013, 2015, 2017, 2018); as such, this is not meant to be representative of a long-term analysis, but rather represents the study period in general.

A YSI 6920 V2 multiparameter water quality sonde was deployed into IBP-C throughout the summers (early June- late August) of 2010-2013, and also for 3 weeks in late summer 2015, to record temperature and dissolved oxygen (DO) every 15 minutes. Data from the optical DO sensor was used to continually estimate NEP at IBP-C using a free-water metabolism (FWM) technique (Cole et al. 2000, Pace and Prairie 2004, Staehr et al. 2010), where hourly NEP is expressed as a function of the change in O2 minus diffusion. Diffusion and other parameters were calculated using formulae and steps described in detail elsewhere (Staehr et al. 2010). Even though there is no period of darkness in June-July in Utqiaġvik, we assumed that PAR at 2am was sufficiently low (Median = 35) to allow for estimation of respiration (R), prior to the sun setting in early August; however, it is worth noting that this assumption may be less robust at the beginning of the summer when the sun does not set. Sensor-based DO was validated against lab analyses using the Winkler method (Wetzel and Likens 2000).

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